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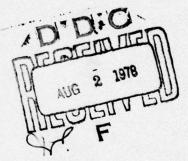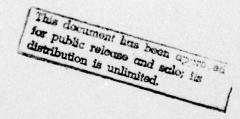| OF |
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by

10 Y. C. Ho

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is an account of the technical work performed on Contract ONR N00014-77-C-0351 which was used to partially support the research leave of the Principal Investigator during the academic year 1977-78.

FINAL REPORT FOR

ONR N00014-77-C-0531

by

Y. C. Ho

The principal investigator spent the academic year 1977-78 visiting

the Electronic Systems Laboratory of M.I.T. and doing research in the

area of Information in Large Systems. Three specific topics are in-

vestigated.

1. Decentralized Control, Signaling, and Real Time Information Theory.

In centralized control, a decision maker is concerned with two

effects of his decisions or controls: (i) direct impact of the decision

on the payoff, (ii) indirect impact of the decision on the payoff by

allowing acquisition of better information for later decisions. The

tradeoff between these two desires is sometimes known as dual control.

When there are more than one decision makers, a third possibility occurs,

that of influencing other decision makers' information through one's

action. This is signaling. The simplest case of signaling is captured

by Information theory under the real time constraints (i.e. no arbitrary

delays are permitted). The application and modification of classical

information-theoretic results to decentralized control problems and

signaling problems in economic organizations represent a difficult and

wide open problem area for future investigation.

The principal investigator was an invited plenary session speaker at

the 1977 International Information Theory Symposium, and an invited

speaker at the Third Kingston Conference on Differential Games and

Mathematical Economics. He spoke on the above topics. He also actively

participated in the supervision of two Ph.D. thesis at M.I.T. in this area.

Two papers were written and published.

2. Data Base and Large Information Systems

Conceptually, a data base appears at first glance as the embodiment of simplicity. Information are stored and retrieved automatically and systematically by straightforward computer routines. However, the sheer size of the volume of data completely destroys this simplicity. Hours of computer time may be required to locate a single piece of data. Thus organization and optimization questions naturally arise in data base management in addition to any hardware, software, and interface problems inherent in any real system. These logical and structural questions fall under the domain of system theory. They have been partially treated by computer scientists. However, it appears that system and control theorist can also make contributions.

The principal investigator spent the year mostly in understanding the issues involved in data base management theory. He also interacted with the Institute of Defense Analysis to learn about real data base systems such as the WWMCC and FORSTAT systems. He initiated two research problems in security and query optimization in DB systems. The effort will culminate in his talk, "A Control Theorist's View of Data Base in C^3," at the August 1978 C^3 Workshop at M.I.T.

3. Management of Large Industrial Systems

It has been clear for sometime that optimization and control problems exist in large industrial systems. However, it has also been clear that usual decision and control techniques of the $\dot{x} = Ax + Bu$ variety are not applicable to the dynamics of such systems. As vehicles for study general problems in this area, we have solved an inventory management problem in a large warehouse and a buffer storage problem in a production line.

The former involves a novel application of the Arrow-Hurwicz decomposition algorithm which in this case reduced an optimization problem involving one million variables to one of twenty-four variables! The latter is a well known problem of long standing for which we have developed an effective successive approximation technique for solution. While it is interesting to solve these specific problems, the overall objective is to discern generally applicable techniques in these systems. It appears that our solution techniques can be applied to other areas of large systems, such as file allocation in distributed computer systems, buffers and queues in networks. Efforts will be continued.

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